CLAIMS

What is claimed is:

1. A method for transporting a substrate into and out of a substrate holding area on a substrate processing apparatus comprising the steps of:

providing the substrate on an end effector of a transport arm, the end effector being rotatably mounted to a wrist of the transport arm;

rotating the transport arm about an axis of rotation at a shoulder of the transport arm to rotate the wrist about the axis of rotation; and

moving the transport arm to radially displace the wrist of the transport arm relative to the axis of rotation at the shoulder of the transport arm, wherein the step of moving the transport arm rotates the end effector about the wrist to rotate the substrate about the axis of rotation at the shoulder of the transport arm in concert with rotation of the wrist about the axis of rotation at the shoulder of the transport arm.

2. A method as in Claim 1, wherein the steps of moving and rotating are harmonized with each other so that the substrate on the end effector is substantially rectilinearly translated with respect to the substrate holding area along an axis of translation extending through a substrate transport passage of the substrate holding area.

3. A method as in Claim 1, wherein the substrate processing apparatus comprises at least two of the

substrate holding areas located side by side to each other, the transport arm transporting substrates into and out of each of the two substrate holding areas, and wherein the axis of rotation at the shoulder of the transport arm stays in one location relative to the two substrate holding areas when the transport arm transports substrates into and out of each of the two substrate holding areas.

4. A method as in Claim 1, wherein the transport arm is an articulated arm comprising an upper arm link and a lower arm link and wherein the step of moving comprises independently rotating the lower arm link relative to the upper arm link.

5. A method for transporting a substrate into and out of a substrate holding area comprising the steps of:

providing the substrate on an end effector of a transport arm;

rotating the transport arm as a unit about an axis of rotation; and

moving the end effector of the transport arm to radially displace the end effector relative to the axis of rotation;

wherein ~~the step of moving~~ movement of the end effector complements ~~the step of rotating~~ rotation of the transport arm about the axis of rotation to result in the substrate being substantially rectilinearly translated into and out of the substrate holding area.

6. A method for transporting substrates into and out of a substrate holding chamber comprising the steps of:

placing an end effector of a transport arm in a first position;

moving the end effector between the first position and a second position along a first path to axially translate a substrate on the end effector through an opening of the substrate holding chamber, the substrate being axially translated along the first path; and

returning the end effector from the second position through the opening of the substrate holding chamber to the first position along a second path, a portion of the second path extending through the opening of the substrate holding chamber being different than a comparable portion of the first path extending through the opening of the substrate holding chamber.

7. A method as in Claim 6, wherein the portion of the second path extending through the opening of the substrate holding chamber is generally described by a portion of an axis connecting a pivot axis of the transport arm at a shoulder of the transport arm to the substrate holding chamber.

8. A substrate transport apparatus comprising:

a drive section; and

a robot transport arm mounted to the drive section, the robot transport arm having a wrist and an end effector to hold a substrate thereon, the end effector being rotatably mounted to the wrist to rotate about the wrist, rotation of the end effector about the wrist being slaved to the robot transport arm;

wherein the robot transport arm is adapted to transport substrates into and out of ~~two~~ three general side by side orientated substrate holding areas with the drive section being located in only one location relative to the ~~two~~ three holding areas.

9. A substrate transport apparatus as in Claim 8, wherein the end effector is slaved to the robot transport arm so that, when the end effector rotates about the wrist relative to the robot transport arm, the substrate on the end effector and the wrist rotate about the drive section at a substantially equal rate.

10. A substrate transport apparatus as in Claim 8, wherein the robot transport arm is mounted to a drive shaft of the drive section, and wherein the end effector is slaved to the robot transport arm so that when the robot transport arm radially translates the end effector relative to the drive shaft the end effector is automatically rotated about the wrist.

11. A substrate transport apparatus as in Claim 10, wherein the end effector rotates about the wrist to rotate the substrate about the wrist so that as the substrate rotates about the wrist, the substrate, the wrist and the drive shaft remain generally aligned.

12. A substrate transport apparatus as in Claim 8, wherein the robot transport arm is an articulated arm comprising an upper arm link and a lower arm link, the upper arm link extending from a shoulder of the robot transport to an elbow of the robot transport arm and the lower arm link extending from the elbow to the wrist of the robot transport arm, and wherein the robot transport arm is mounted at the shoulder to a drive shaft of the drive section.

13. A substrate transport apparatus as in Claim 12, wherein the upper arm link is mounted to the drive shaft to rotate in unison with the drive shaft, and wherein the lower arm link is rotatably mounted to the upper arm link to rotate relative to the upper arm link.

14. A substrate transport apparatus as in Claim 12, wherein the robot transport arm includes means for automatically rotating the end effector about the wrist, and wherein the means for automatically rotating the end effector drivingly connect the lower arm link to the end effector slaving rotation of the end effector about the wrist to the rotation of the lower arm link about the elbow.

15. A substrate transport apparatus as in Claim 12, wherein the upper arm link and the lower arm link are rotated independently of each other to effect robot transport arm transport of substrates into and out of the ~~two~~ three substrate holding areas.

16. A substrate transport apparatus as in Claim 8, wherein the robot transport arm transports substrates substantially rectilinearly into and out of each of the ~~two~~ three substrate holding areas along axes of translation corresponding to each holding area.

17. A substrate transport apparatus as in Claim 16, wherein the axes of translation of the ~~two~~ three substrate holding areas are substantially parallel to each other.

18. A substrate transport apparatus as in Claim 17, wherein when the robot transport arm transports substrates into and out of the ~~two~~ three substrate holding areas the drive section is located between the axes of translation of ~~one~~ any two substrate holding areas.

19. In a substrate processing apparatus comprising a frame with a plurality of side by side substrate storage areas, a robot transport arm pivotably mounted to the frame to transport substrates between the substrate storage areas and a substrate holding area, the robot transport arm having an end effector and a wrist, the end effector being pivotably mounted to the wrist of the robot transport arm, wherein the improvement comprises:

the robot transport arm being adapted to substantially rectilinearly move substrates into and out of at least two of the plurality of side by side substrate storage areas along axes of translation corresponding to each of the two substrate storage areas, wherein an axis about which the robot transport arm pivots relative to the frame stays in one location relative to the frame when the robot transport arm moves substrates into and out of each of the two substrate storage areas, and wherein the end effector is slaved to the robot transport arm to rotate automatically about the wrist when the robot transport arm moves substrates into and out of each of the substrate storage areas.

20. A substrate transport apparatus as in Claim 19, wherein when the robot transport arm moves substrates into and out of each of the two substrate storage areas, the axis about which the robot transport arm pivots is located between the axes of translation of the two substrate storage areas.

21. A substrate transport apparatus as in Claim 19, wherein the two axes of translation of the two substrate storage areas are substantially parallel to each other.

22. A substrate transport apparatus as in Claim 19, wherein the robot transport arm is an articulated arm comprising an upper arm and a lower arm, the upper arm being independently rotatable about the axis about which the robot transport arm pivots and the lower arm being independently rotatable relative to the upper arm.

23. A substrate transport apparatus comprising:

a robot transport arm with an end effector to hold a substrate thereon;

means for rotating the robot transport arm about a first axis of rotation, the means for rotating the robot transport arm comprising a first drive mechanism being drivingly connected to the robot transport arm to rotate the robot transport arm as a unit about the axis of rotation;

means for linearly displacing the end effector of the robot transport arm, the means for displacing the end effector comprising a second drive mechanism drivingly connected to the robot transport arm to substantially radially displace the end effector relative to the axis of rotation; and

a controller controlling the means for rotating the robot transport arm and the means for displacing the end effector to provide compound rotation of the robot transport arm about the axis of rotation with radial displacement of the end effector relative to the axis of rotation to result in general rectilinear

translation of the substrate into and out of a substrate holding chamber.

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